with Travese
16-30

## CLAIMS

1. A method for controlling an ion implantation process, comprising:

generating an ion beam;

determining an ion beam current reference level;

measuring an ion beam current during implantation of a semiconductor wafer; and

adjusting an ion implantation parameter to compensate for vacuum fluctuations during implantation based on the reference level and the measured ion beam current, and not based on a detected pressure.

2. The method of claim 1, wherein the step of determining an ion beam current reference level comprises:

measuring an ion beam current before implantation of the semiconductor wafer begins.

3. The method of claim 1, wherein the step of determining an ion beam current reference level comprises:

measuring an ion beam current while a vacuum level along an ion beam path is stable.

4. The method of claim 1, wherein the step of determining an ion beam current reference level comprises:

retrieving a stored reference level from a memory.

5. The method of claim 1, wherein the step of determining an ion beam current reference level comprises:

measuring an ion beam current using a Faraday detector.

6. The method of claim 1, wherein the step of determining an ion beam current reference level comprises:

measuring an ion beam current using a sampling Faraday detector positioned adjacent a wafer implantation position.

7. The method of claim 1, wherein the step of measuring an ion beam current comprises:

measuring an ion beam current using a Faraday detector positioned adjacent the semiconductor wafer.

8. The method of claim 1, wherein the step of measuring an ion beam current comprises:

measuring an ion beam current while a vacuum level along a beam line is changed from a reference vacuum level.

9. The method of claim 1, wherein the step of adjusting an ion implantation parameter comprises:

adjusting a wafer scan rate that determines the rate at which the wafer traverses the ion beam based on a difference between the ion beam current reference level and the measured ion beam current.

10. The method of claim 1, wherein the step of adjusting an ion implantation parameter comprises:

determining a difference between the ion beam current reference level and the measured beam current;

scaling the difference value to account for non-line of sight charge exchanging collisions of ions in the beam; and

adjusting a wafer scan rate based on the scaled difference value.

11. The method of claim 1, wherein the step of adjusting an ion implantation parameter comprises:

adjusting ion implantation parameters to adjust for wafer dosing non-uniformity in two dimensions.

12. The method of claim 11, wherein the step of adjusting comprises:

adjusting a wafer scan rate and a beam scan rate.

13. The method of claim 12, wherein the step of adjusting comprises:

adjusting the wafer scan rate and beam scan rate based on two scale factors.

14. The method of claim 1, wherein the step of adjusting an ion implantation parameter comprises:

using a scale factor that is mathematically derived by modeling an implantation system.

Sub. A'

15. The method of claim 14, wherein the step of using a scale factor comprises:

using a scale factor that as been determined based on calculated beam path length *neutral particle density products that are obtained, at least in part, from a model of an ion beam path and a vacuum system.

1

~~16~~. An ion implantation system comprising:

means for generating an ion beam;

means for determining an ion beam current reference level;

means for measuring an ion beam current during implantation; and

means for adjusting an ion implantation parameter to compensate for vacuum fluctuations during implantation based on the reference level and the measured ion beam current, and not based on a detected pressure.

2

~~17~~. An ion implantation system comprising:

a beam generator that generates an energetic ion beam and directs the beam toward a semiconductor wafer;

a detector that detects an ion beam current;

a wafer drive that moves the semiconductor wafer in a direction transverse to the ion beam path; and

a controller that receives signals from the detector representative of a detected ion beam current, detects a vacuum fluctuation based on the detected ion beam current, and controls the wafer drive to adjust a wafer scan rate to compensate for the vacuum fluctuation during implantation.

3 ~~18~~. The apparatus of claim 2 ~~17~~, wherein the controller scales the difference value to account for non-line of sight and line of sight charge exchanging collisions experienced by ions in the beam along the ion beam path.

4 ~~19~~. The apparatus of claim 3 ~~18~~, wherein the difference value is scaled based on a ratio of line of sight collisions to non-line of sight collisions.

5 ~~20~~. The apparatus of claim 2 ~~17~~, further comprising a vacuum system, and wherein the controller controls the vacuum system to begin evacuation based on the determined difference value.

6 ~~21~~. The apparatus of claim 2 ~~17~~, wherein the detector is a Faraday cup positioned adjacent a semiconductor wafer.

7 ~~22~~. The apparatus of claim 2 ~~17~~, wherein the beam generator includes an angle corrector magnet.

8 ~~23~~. The apparatus of claim 2 ~~17~~, wherein the ion beam current reference value is determined based on an ion beam current measured while a vacuum level along the ion beam path is stable.

9 ~~24~~. The apparatus of claim 2 ~~17~~, wherein the ion beam current reference value is retrieved by the controller from a memory.

10 ~~25~~. The apparatus of claim 2 ~~17~~, wherein the controller detects a vacuum fluctuation based on a difference value between an ion beam current reference value, which corresponds to an ion beam current in the absence of vacuum fluctuations along an ion beam path, and an ion beam current measured in the presence of vacuum fluctuations along the ion beam path.

11 ~~26~~. The apparatus of claim 2 ~~17~~, wherein the controller adjusts an ion implantation parameter in addition to the wafer scan rate to adjust for wafer dosing non-uniformity in two dimensions.

~~27.~~ 12. The apparatus of claim ~~17~~ 2, wherein the controller adjusts a wafer scan rate and a beam scan rate.

~~28.~~ 13. The apparatus of claim ~~27~~ 12, wherein the controller adjusts the wafer scan rate and beam scan rate based on two scale factors.

~~29.~~ 14. The apparatus of claim ~~17~~ 2, wherein the controller adjusts the wafer scan rate using a scale factor that is mathematically derived by modeling the implantation system.

Sub A2

30. The apparatus of claim 29, wherein the controller uses a scale factor that has been determined based on calculated beam path length *neutral particle density products that are obtained, at least in part, from a model of an ion beam path and a vacuum system in the implantation system.

31. A method for controlling an ion implantation process, comprising:

generating an ion beam;

directing the ion beam along a beamline;

detecting a beam current along the beamline;

detecting a vacuum fluctuation along the beamline based on the detected beam current; and

adjusting an ion implantation parameter to compensate for the vacuum fluctuation during implantation.

32. The method of claim 31, wherein the step of detecting a vacuum fluctuation comprises:

determining a difference value between an ion beam current reference value, which corresponds to an ion beam current in the absence of vacuum fluctuations along an ion beam path, and an ion beam current measured in the presence of vacuum fluctuations along the ion beam path.

33. The method of claim 32, wherein the step of detecting a vacuum fluctuation comprises:

scaling the difference value based on a ratio of line of sight collisions to non-line of sight collisions.

34. A method for controlling an ion implantation process, comprising:

generating an ion beam;

directing the ion beam along a beamline;

detecting a beam current along the beamline;

implanting a material with ions in the ion beam; and

compensating for the vacuum fluctuation during implantation based on detected beam current and not based on a detected pressure.